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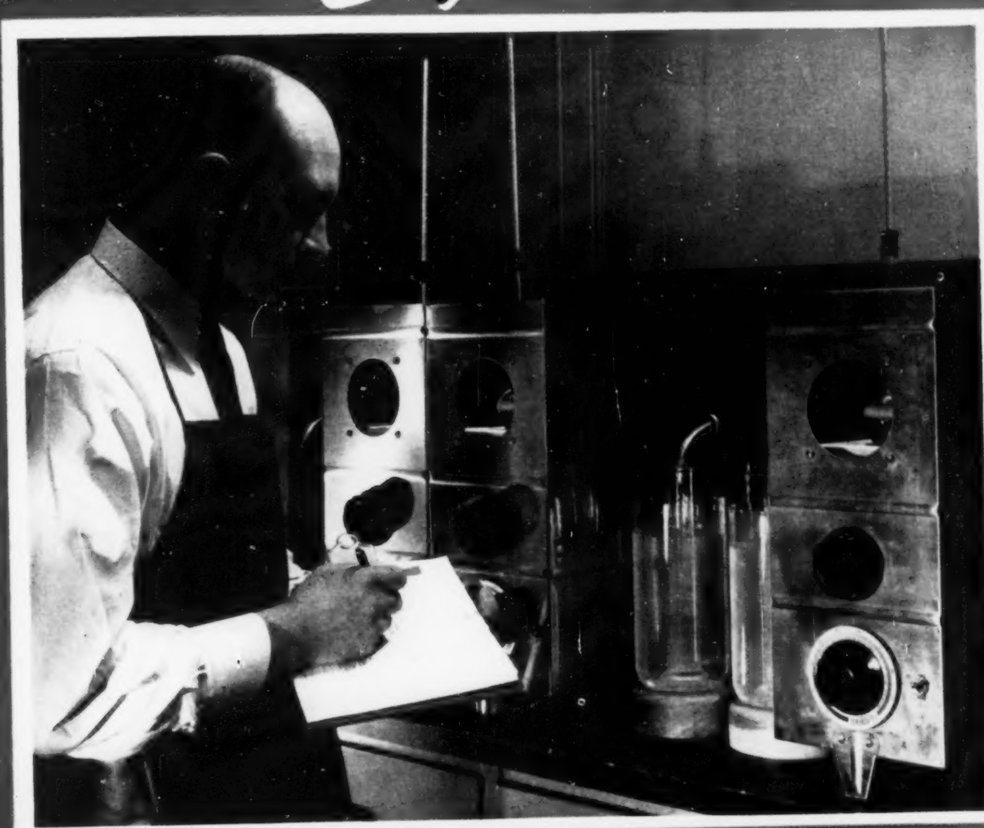
The INSTITUTE Spokesman



"Precision" Front View
Distillation Unit
(See Page 29)

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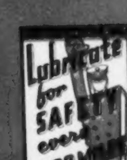
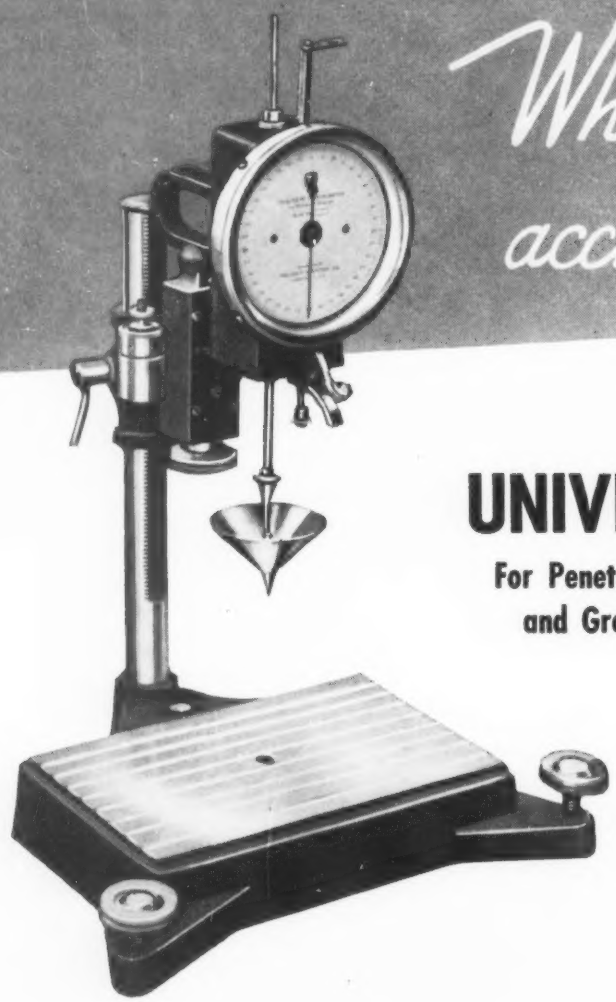


Official Publication of NATIONAL LUBRICATING GREASE INSTITUTE



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President's page

by **B. G. Symon, President N.L.G.I.**

At the beginning of each year, it is customary for a columnist to turn fortune teller and predict what the coming year has in store. It would please me greatly if I felt qualified to join the crystal ball experts and call the turn on economic prospects for the grease industry in 1949—but I don't.

Instead of doing a Kiplinger, therefore, I'm going to confine my predictions to one: 1949 will be one of the most active years in the history of the National Lubricating Grease Institute, thanks to the high-voltage committees which are handling various phases of our program. All committees are making good progress towards completing their program goals.

The Technical Committee, for example, under the chairmanship of T. G. Roehner of Socony-Vacuum Oil Company, is doing an excellent job in lining up worthwhile technical articles for the "Spokesman". In this connection, I want to call your attention to two articles in this issue — "Lubrication of Anti-Friction Bearings from a Bearing Manufacturer's Standpoint", by Mr. H. Reynolds, and "Four Point Cooperation for Optimum Lubrication Results," by Mr. Howard Cooper. Articles of this nature are practically valuable because they give us a helpful viewpoint on our industry from people in other fields.

When I started to write this article a summary was made of the progress accomplished by our Technical Committee. You will be as amazed as I when you read this summary of their accomplishments.

In addition to forming two committees designed to obtain and review technical articles for our "Institute Spokesman", they have also completed a project started last June when a committee panel was formed to study the "Delivery Characteristics of Dispensing Equipment for Lubricating Greases". These exploratory tests have been completed, a summary made and assembled by Mr. Roehner who has distributed these findings to the members of the panel for their further consideration as to future action.

Quite some time ago a member of the Institute suggested that the Spokesman contain abstracts which would be published each month. This subject was discussed at the Technical Committee meeting on October 13, 1948; when favorable consideration was given to the proposal that an up-to-date bibliography on grease subjects be published in "The Institute Spokesman". Immediately following this meeting Mr. Roehner submitted a questionnaire to a representative cross section of the N.L.G.I. Technical Committee asking their opinion on whether or not we should publish abstracts. This questionnaire has been returned to your Institute office for further consideration.

Vice President A. J. Daniel, who is chairman of our Program Committee for 1949, has given me the astonishing news that 201 hotel reservations have already been made for our 1949 Annual Meeting in New Orleans. We are still ten months away from this meeting with our membership interest increasing with each day. Plans for an outstanding 1949 program were immediately started following our 1948 Annual Meeting. It is my understanding that plans for our 17th Annual Meeting are well under way, and rapidly taking form.

Mr. W. W. Albright, chairman of our Membership Committee, has been active in gathering lists of organizations who could benefit by affiliating themselves with us.

As specific progress reports come in from the various committees, they will be passed along to members through this column.

Once again, a Happy and Prosperous New Year to everyone. I hope 1949 will prove such a banner year that it will serve as an inspiration to us for many years to come.

LUBRICATION of Anti-Friction Bearings *from a* Bearing Manufacturer's Standpoint

MR. H. REYNOLDS
The Fafnir Bearing Company

The unanswered question is which came first the bearing or its lubricant? Obviously lubricant would not be required if we did not have bearings. Just as obviously present day bearings without lubrication would not be satisfactory.

The bearing manufacturer's side of the story can be expressed in a few words taking about a minute. We are looking for a lubricant that has a temperature range from minus 90°F to plus 400°F that will not change consistency over this range and which will not break down when churned in an anti-friction bearing regardless of load and speed. It should perform without a noise level and without temperature change; further it should be ageless and finally the original supply should lubricate indefinitely. These simple requirements have been met, but only verbally.

Seriously anti-friction bearing manufacturers owe a large measure of their products' satisfactory service to the excellent lubricants now available and with a few special exceptions, standard anti-friction bearing lubricants meet the needs of our customers satisfactorily.

However ,we have found it necessary to exercise some control over the type and kind of lubricant used with our bearings, as to when, where and how much.

This has required the developing of testing equipment which will not only evaluate lubricants for our needs but which will also enable us to identify characteristics which are needed to insure proper duplication of satisfactory material.

A great help to our checking is any information available from the lubricant manufacturer. Our company has a blank form which we ask the lubricant producer to fill in. We appreciate that some of these data you do not have. Just fill in the information you do have; it eliminates duplication in our laboratory.

Some of our tests may seem unnecessary but they eliminate materials with obvious shortcomings, insure uniformity from batch to batch, and enable us to make field comparisons of similar lubricants.

Routine lubricant tests embrace many distinct and separate steps requiring direct labor for a period of 16 to 20 hours per sample and in some tests an elapsed time of 500 hours. If the sample equals or betters results established as satisfactory, then these materials are further checked by actual load life running tests. These running tests are sometimes continued for 30,000 hours. Laboratory tests do not establish the lubricating value of our sample: only load life tests establish that. Unfortunately, due to lack of time and equipment these load life tests cover only a limited range of conditions.

The Annular Bearing Engineers' Committee have agreed on certain tests for lubricating greases. These tests, sometimes slightly modified, are used as a preliminary check on all samples submitted for our evaluation.

Slides illustrating some of these tests will be shown and briefly described.

Storage Bleeding (Fig. 1)

One of our basic requirements of a suitable grease for lubricating ball bearings is that there be no excessive bleeding of the oil from the soap either from standing or from operation. To determine this characteristic, the storage bleeding test has been devised. A glass jar of approximately 2 oz. capacity, with a wide mouth (about 1¼" diam.) is filled with the grease sample. A cone shaped depression is formed in the grease having the same base diameter as the mouth of the jar with its apex located about 1¼" from the top of the jar. The jar is then placed in shelf storage at room temperature for about a month. At the end of this time, bleeding is checked by measurement of the free oil collected in the apex of the conical cavity.

Separation at 212° Fahrenheit (Fig. 2)

We check for separation as follows: A grease sample of approximately 10 grams weight is placed in a 60 mesh cone of about 2¼" base diameter which is supported in a suitable mounting over a 100 ml. beaker that has been cleaned and

weighed. The assembly is then placed in a gravity convection oven where it is maintained at a temperature of 100° Centigrade (212°F.) for a period of 50 hours. At the end of this period it is removed, cooled in a desiccator and the beaker is weighed. The difference between the initial and final weights of the beaker is the amount of oil that has separated from the grease. Some government specifications limit the loss indicated in this manner to 5% of the sample, others permit no separation whatsoever.

This same test also serves to indicate the loss of oil from the sample by evaporation. The loss from evaporation is again checked as loss of weight but this time we take the final weight of beaker, cone, and grease from the initial weight of same. A limit of 15% in 50 hours at 212°F. is considered satisfactory for general purpose greases.

Dirt Count (Fig. 3)

The dirt count is a simple test designed to give an approximate idea of the amount and size of the particles contained in a sample.

We perform this check as follows: Upon a thoroughly cleaned porcelain plate on the surface of which a grid 100 square centimeters in area has been ruled a 0.3 cubic inch grease sample is spread to a uniform film .010 thick using a clean sheet of transparent pliofilm as a cover and is then examined under 10 power binoculars.

The number and size (whether large or small) of dirt particles per square centimeter is recorded and checked against our established standards for a commercially clean grease.

No standards for dirt count have been established, neither has a method. We note that some products are consistently clean while others are continuously reported as containing dirt in sufficient quantity to affect the smooth-operation of an assembled anti-friction bearing in which it is used.

We filter all grease used in prelubricated ball bearings so that we are not seriously disturbed by a small amount of dirt. However, our customers relubricate our bearings and we hesitate to approve a grease containing noticeable solids.

Oxidation Bomb Test (Fig. 4) (Fig. 5) (Fig. 6)

The Norma Hoffman Bomb Test was developed to determine the

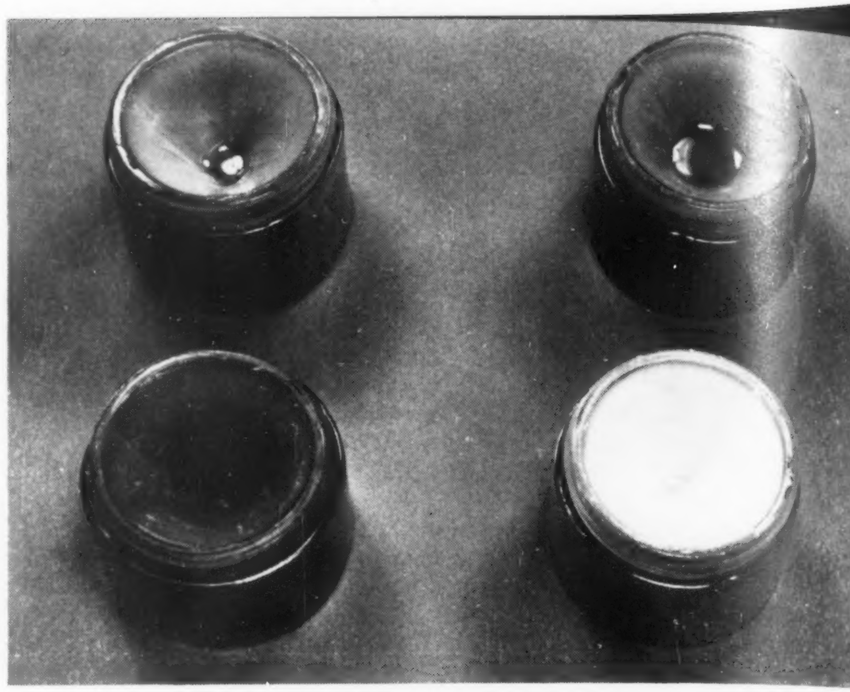

Fig. 1—Storage Bleeding.

Fig. 2—Evaporation and separation test.

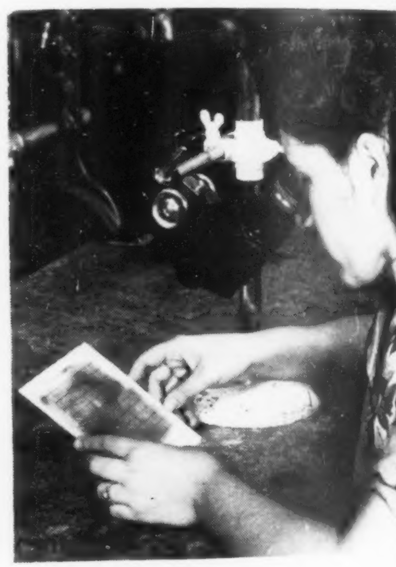

Fig. 3—Dirt Count.

Fig. 4—Oxidation Bomb Test.

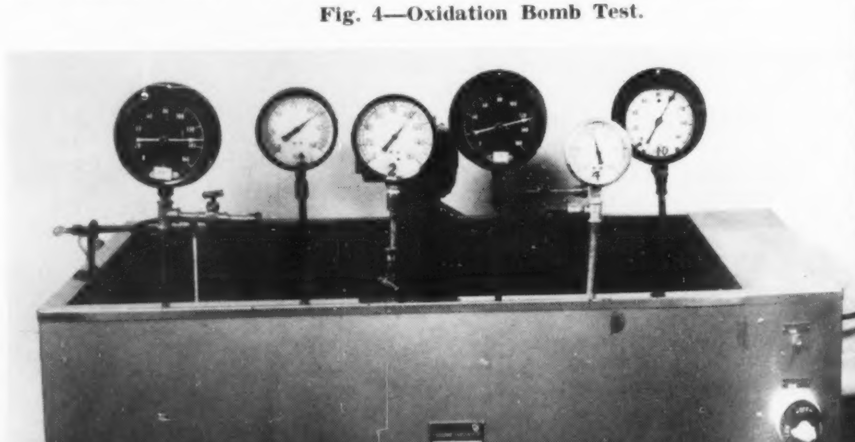

Fig. 5—Oxidation Bomb Disassembled.

Fig. 7—Melting Point Test.

chemical stability of a grease. It is a static test in which grease samples are placed in shallow glass dishes on a rack and subjected to oxidation at an accelerated rate under controlled pressure and temperature. The oxidation resistance of a sample can thus be evaluated in terms of years based on the induction or breakdown point of the grease.

The apparatus (Fig. 5) consists essentially of a stainless steel "Bomb" fitted with a valve for filling with oxygen under pressure and provided with a gage to indicate the initial pressure, and the drop in pressure as the grease sample absorbs oxygen. The bomb is held at a constant temperature in an oil bath during the test. For convenience this bath is large enough to hold several bombs thus permitting the testing of a number of greases at one time.

Breakdown of the readily oxidizable constituents in a grease occurs in two stages. The first is termed the induction period during which the reaction rate, as indicated by the pressure drop, is comparatively slow as only a slight chemical change is taking place. After some time the second stage begins, this stage is indicated by a sharp rise in the pressure loss curve indicating that more rapid chemical change is occurring. When this point is reached, the induction period is at an end. The length of time involved in the induction period is indicative of the chemical stability of the sample under test. Typical curves are shown in Fig. 6.

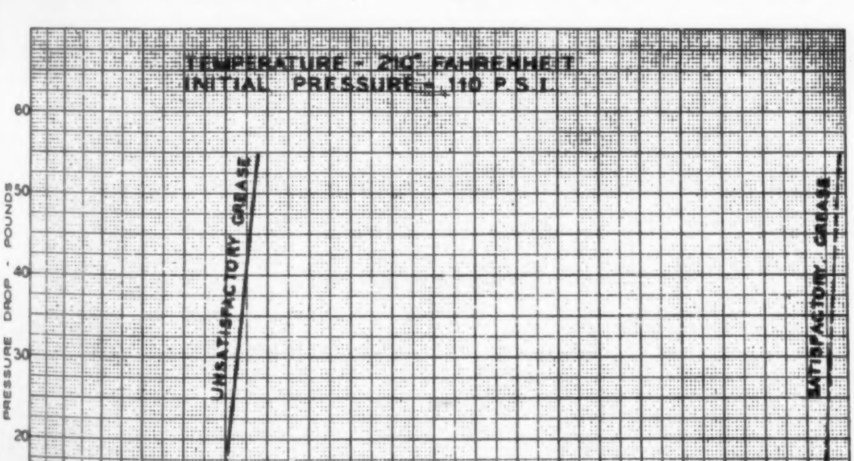

Fig. 6—Rate of Breakdown of Oxidizable Constituents in a Grease.

A grease considered good for anti-friction bearing use should show no noticeable change in color, consistency or appearance until the end of the induction period which has been fixed as a minimum.

The bomb test, regardless of results, does not predict the lubricating value of a grease. It must be supplemented by other tests.

It is a quick check for estimating storage life and we find the following approximate correlation exists between the length of time involved in the induction period and safe shelf storage life.

Induction Period 50 hours.
Induction Period 150 hours.
Induction Period 500 hours.
Safe Shelf Life less than 1 year.
Safe Shelf Life 2 to 3 years.
Safe Shelf Life more than 4 years.

A further use for the oxygen bomb is the checking of bearing materials with lubricants for compatibility.

To illustrate, brass or bronze act as accelerators in the oxidation of some lubricants. Not much trouble occurs where bearings are relubricated but the use of brass or bronze as retainer material in prelubricated assemblies is accompanied by much head shaking and dark looks. Proof must be furnished even the office cat that the lubricant selected and the retainer material will live together peacefully. We also check seal materials in the bomb with the lubricant we expect to use.

Melting Point (Fig. 7)

The Annular Bearing Engineers' Committee have adopted a slightly modified A.S.T.M. drop point test for lubricating greases.

The equipment used (Fig. 7) consists of a metal cup with a small hole in the bottom, suspended in a test tube which, in turn, is immersed in a heated bath of transparent oil. A sample of the grease to be tested is spread on the inside walls of the cup and a thermometer is placed in the test tube with its bulb just clearing the hole in the cup. Heat is applied to the oil bath at a fairly rapid rate until the thermometer registers approximately 20°F. below the anticipated melting point of the sample. When this point is reached the heating is continued at a slower rate and careful observation is made of the temperature at which the first drop

of grease falls through the hole in the cup to the bottom of the test tube. This temperature is taken as the melting point of the grease. And who cares; except for comparative purpose the test is almost valueless.

Anti-friction bearings beat up the lubricant and the combined agitation and resulting temperature results in a softening of the grease at temperatures considerably below the melting point.

Corrosion Test (Fig. 8)

Freshly polished copper strips are spread with a thin film of the sample grease. Some of the coated strips are set aside at room temperature in the laboratory for a period of 48 hours and others in an oven at a temperature of 160°. for 24 hours. After these exposures the strips are cleaned with petroleum ether and compared with newly polished strip. Any noticeable stain is cause for rejection of the grease causing it.

Consistency (Fig. 9)

Consistency is a numerical measure of the relative hardness of a grease.

Anti-friction bearing users of greases define it further as worked or unworked consistency. Unworked, is fresh stock as received—Worked, is the grease after churning in an anti-friction bearing or after an active period in some type of mechanical beater. A milled grease is considered one that has been preworked by the manufacturer. Many of the present greases sold for use with anti-friction bearings are milled. We have a term "Milled to Penetration Stability". Such greases have very slight mechanical change when used with anti-friction bearings.

We check consistency with an American Society of Testing Materials Penetrometer, however Fig. 9 illustrates a miniature machine developed by the Annular Bearing Engineers' Committee. This small unit is necessary because of the small amount of grease involved in our tests.

Test Procedure is as follows: For unworked grease a sample as received is placed in the cup and leveled off. The point of the cone is placed on the surface of the grease and the indicator dial set at zero. The cone is released and allowed to sink into the grease. The penetration is allowed to continue for 5 seconds. The depth of its penetration is measured directly on the indicator. The indicator reading is translated from a table in a Penetration Number. Temperature during test is held at 77°F. + or — 3°.

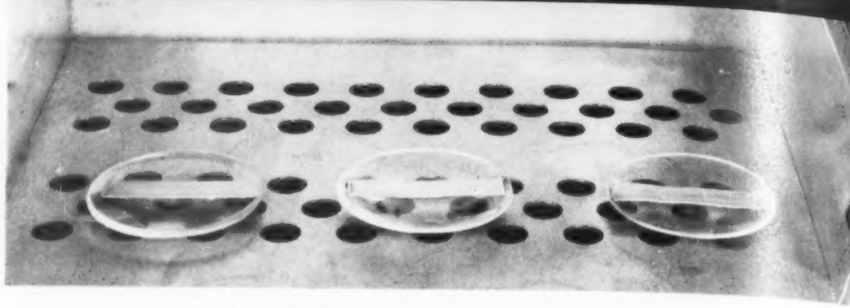

Fig. 8—Corrosion Test on Copper Strips.

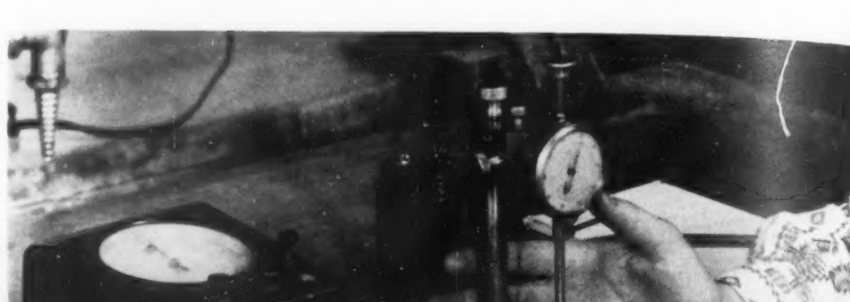

Fig. 9—Unworked Consistency Test with Miniature Penetrometer.

Fig. 10—Consistency Test at —15°F.

Consistency is an important property to be considered in the selection of an anti-friction bearing grease. Such factors of use as housing design, method of application, use in prelubricated ball bearings, resistance to solvent fumes, channeling and other requirements decide the issue. So far no type or consistency of grease meets all conditions. In considerable favor, however, and generally satisfactory for average use is a consistency between 250

and 300 A.S.T.M. when tested in accordance with A.S.T.M. procedure.

Low Temperature Test (Fig. 10)

To check the temperature range of any grease or its consistency at zero or lower our laboratory used the apparatus shown in (Fig. 10). This is a cold box equipped with an ABEC Miniature Penerometer. The cup of the penetrometer is filled slightly over level with the grease to be tested and placed in the cold box to chill for a period of twenty to twenty-five minutes at —15°F. The cup is then placed in the cup holder and the point of the cone set just even with the top of the grease. The cone is released and penetration into the sample is checked at the end of 5 minutes. At least two tests are run and the results averaged.

We believe a satisfactory grease for general ball bearing lubrication should not be harder than A.S.T.M. 200 at —15°F. nor softer than A.S.T.M. 340 at +200°.

Low Temperature Torque Test (Fig. 11) (Fig. 12)

The object of low temperature torque testing of ball bearing greases is to determine the increase in resistance to rotation induced by low temperatures. To insure reproducible results in various laboratories the ABEC and the NLGI collaborated on the design which consists of a cold box (Fig. 11) and a spindle assembly (Fig. 12) incorporating a 204 Conrad bearing to which the test sample of grease is applied.

The box is brought down to and held at the desired low temperature for the specified time. A 2000 gram centimeter load is applied and the time necessary for one complete revolution is recorded. After a lapse of 15 minutes the load is applied in the opposite direction and the time for a complete revolution is again determined. Government specifications require some additional low temperature tests. But we run these tests only on greases for aircraft service.

Fig. 11—Cold box used in Low Temperature Torque Test.

ABEC Machine (Fig. 13 & 14)

This machine permits visual observation of the grease sample under test in actual operation in a ball bearing under predetermined conditions of speed, time, and temperature. The machine shown in Figures 13 and 14 was developed by the Annular Bearing Engineers' Committee. It incorporates a fractional horse power motor attached directly to a shaft carrying a 204 Conrad grease shielded bearing. This bearing is enclosed in an oil jacketed housing heated by a gas flame; it permits observation of grease behavior under a wide temperature range. The machine also checks both starting and running torque. Grease sample under test is subjected to both agitation and heat. The trained observer will note torque, separation, aeration, leakage, changes in consistency, texture, volume and color.

The test methods and procedures are standardized by the Annular Bearing Engineers' Committee. The results are comparative and it requires a large number of samples of different greases to develop guiding values.

Other things being equal greases showing the least change from original condition are considered most desirable and we use the ABEC machine to quickly screen out samples possessing undesirable mechanical qualities.

Water Resistance (Fig. 15, 16 & 17)

One thing as sure as taxes is that water should be kept out of anti-friction bearings. Fot wet applications we design the application so water is kept out. However, we have numerous calls from Government agencies and industry for water resistant lubricants to be used with our product.

We check by the ABEC method (Fig. 15). This test consists of spreading a thin film of the sample on a clean porcelain plate and placing on it several drops of distilled water containing 5% of a 1% alcoholic phenothalein solution. If after 15 minutes no alkaline reaction occurs, the grease is considered water resistant.

We also use the Army-Navy test which requires more elaborate equipment (Figs. 16 and 17). In this test a number 204 Conrad type ball bearing is weighed, packed with 4 grams of grease and then mounted on the horizontal shaft of a motor in a spe-

(Continued on Page 13)

LUBRICATION OF ANTI-FRICTION BEARINGS

(Continued from Page 11)

cial metal housing. There is a small clearance between the face plate of the housing and 1/32 clearance between this plate and the smaller plate which clamps on the motor shaft. A stream of water flowing through a 1mm nozzle at the rate of 300ml per minute is impinged against the face of the housing ¼" above the 1/32 opening.

The bearing is revolved at 600 RPM for a period of 1 hour. At the end of this time the bearing is removed, dried out at 180°F. and reweighed to determine the grease loss. The difference between the final weights divided by the original weight of the grease is expressed in percentage; if the loss is less than 50% the grease is approved as water resistant.

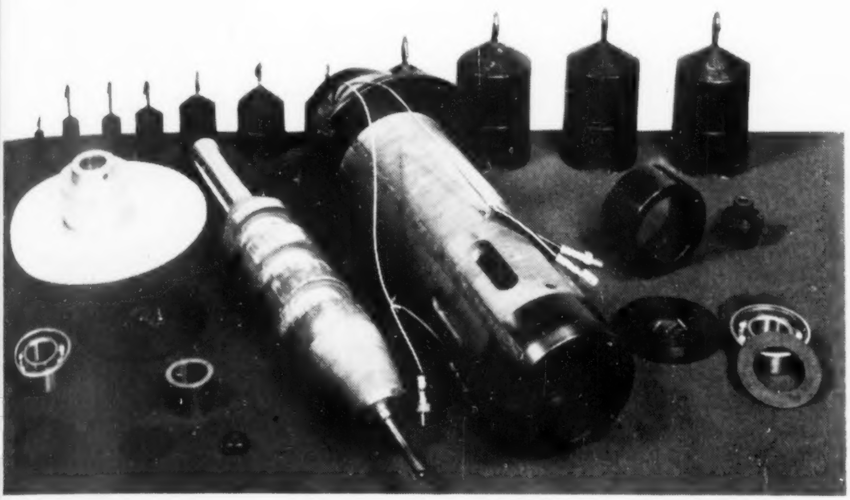

Fig. 12—Spindle assembly from Low Temp. Torque testing apparatus.

Fig. 13—ABEC Torque Test for mechanical stability.

Qualitative Analysis of Soap Content (Fig. 18)

We are equipped to check greases for kind and percent of soap base. We appreciate getting this information direct from our supplier as at the best our determinations are not too positive.

One of our tests checks the kind of soap by dipping a piece of platinum wire into a prepared sample and inserting the coated wire into the flame of a bunsen burner. Fig. 18. It makes a pretty picture and also tells us the nature of the soap. Yellow for sodium, brick red for calcium, carmine for lithium and green for barium.

Our checking for type of soap is for comparison only between lots or between different brands.

Oil Viscosity (Fig. 19)

We rely entirely on our supplier to give us the viscosity and percent of oil in his product. In general we prefer a viscosity above 250 and below 1000 S.U.V. at 100°F. The lighter oils tend to vaporize off while most of the heavier oils have poor low temperature characteristics.

The greases meeting our requirements best for general relubricating of anti-friction bearings have an oil viscosity between 250 and 300 S.U.V. and are compounded with petroleum oils.

We have investigated various new oils (or perhaps I should say syn-

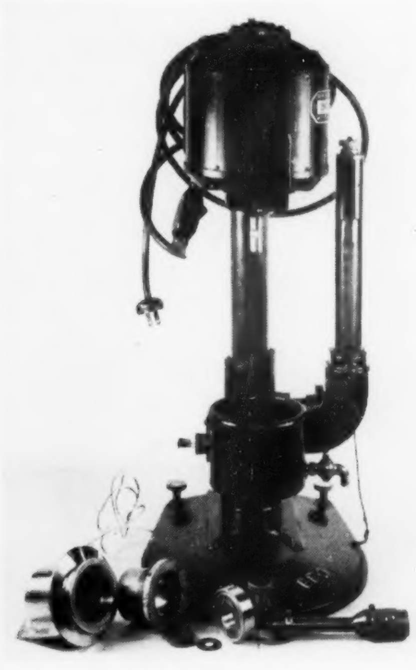

Fig. 14—ABEC Torque Test machine disassembled.

thetic lubricants) compounded with soaps as greases and also separately as oils. No new tests have been devised to check these materials. They generally pass existing tests for petroleum products with high scores. This is especially true when high temperature and moisture are both present.

The Fafnir Oscillation Test Machine (Fig. 20, 21 & 22)

The Fafnir Bearing Company have built a test machine for checking the lubricating value of different compounds in anti-friction bearing applications where the bearings do not rotate but are subjected to limited oscillation under heavy loads. (Fig. 20). When this machine was designed we also thought it might give an approximate comparison of the basic lubricating qualities of one lubricant to another. So far we cannot claim satisfactory correlation. We have furnished assembly and detail drawings to a few interested laboratories and will be glad to furnish additional sets of prints to those interested. The apparatus consists of a base supporting a vertical stationary shaft on which a collar containing two small thrust type ball bearings is mounted. The collar is oscillated by means of a connecting rod operated by an electric motor. Load is imposed by a calibrated spring adjusted by collars screwed onto the vertical shaft. Before as-

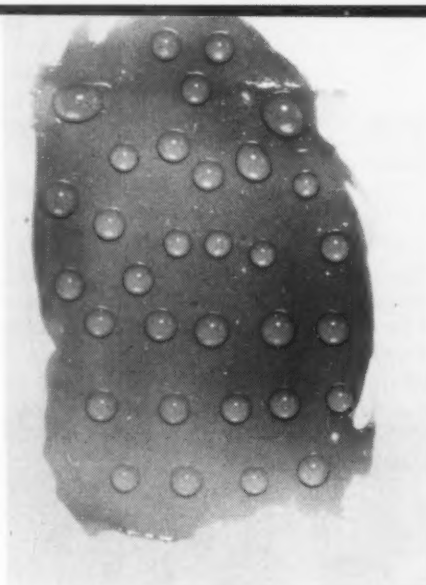

Fig. 15—ABEC Water Resistance Test.

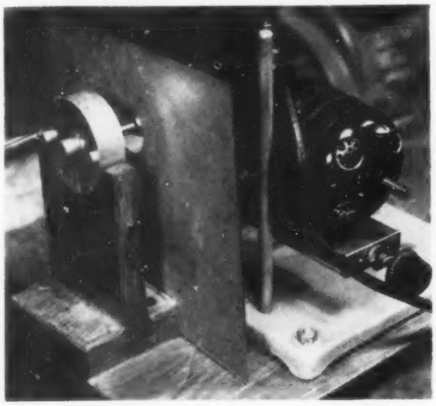

Fig. 16—Army-Navy Water Resistance Test.

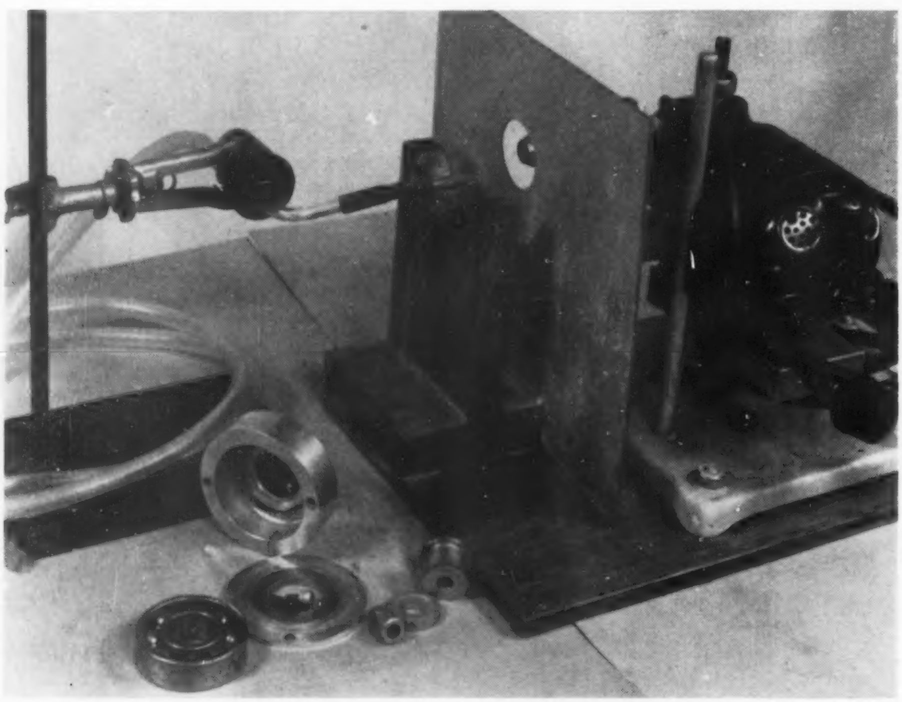

Fig. 17—Apparatus for Army-Navy water resistance test shown disassembled.

sembly (Fig. 21) the thrust bearing parts are carefully cleaned and accurately weighed and the grease to be tested is applied to them. The machine is then started and run for 50 hours. The bearings are then disassembled and again cleaned and weighed. The difference between the initial and the final weights indicates the amount of wear, which is the index of the lubricating quality or as we call it the "Friction Oxidation Resistance" of the grease. A new set of thrust bearing parts is needed for each test.

The illustration (Fig. 22) shows a group of selected bearing parts which demonstrate the relative lubricating values of several greases. Failure of a grease under the conditions of this test does not necessarily mean that it is a poor lubricant under all conditions.

We considered a weight loss of not over .002 of a gram as excellent; from .010 to .020 as average; over .100 is poor. However, many greases with other necessary qualities are accepted even though their friction oxidation wear is high.

To check our results from the oxygen bomb we give all samples

Fig. 18—Flame testing for type of metallic soap base.

which check as satisfactory a shelf storage test. Bearings are packed in the usual way and dated and placed on the shelf for periodical inspection. We look for change in color, consistency, odor or other changes which indicate chemical breakdown.

Other Tests

In the last 10 years the need for lubricants which will perform satisfactorily at increasingly higher temperatures has received consideration from the bearing companies, the American Society for Testing Materials, the Armed Forces of the United States, the N.L.G.I. and numerous private companies.

Various means have been suggested for checking so called high temperature lubricants but no agreement has yet been reached as to the ideal test. This condition is apt to continue for some time yet. In the meantime, producers are experimenting trying to meet one set of requirements only to find that still further needs are developing. Of what use is the lubricant that will

(Continued on Page 18)

3 EASY WAYS T

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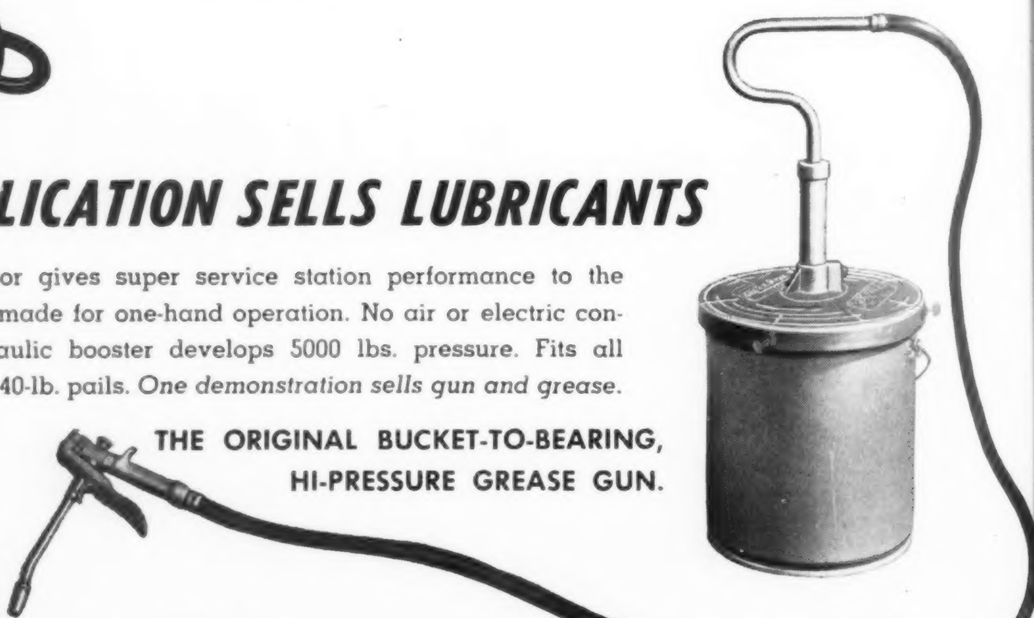

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The Most Economical Gear Lube Dispensing Unit Ever Introduced . . . efficient . . . fast . . . clean

NATIONAL . . .

GEAR-GRE-ZOR

Trademark

3 STROKES... 1 POUND

Simple to assemble — easy to use . . . that's why the Gear-Gre-Zor sells on sight . . . and it's so economical the user will want one for each grade of lubricant. . . . Industrial plants can use several. Made of rust-proof steel and cast aluminum . . . 5 feet of sturdy hose . . . fits all standard 25- or 40-lb. lug cover pails. Recommended for use with SAE 80-90-140 gear lubes.

A sure-fire sales promotion item that will help you sell more gear lubricants.

812 NORTH MAIN — WICHITA, KANSAS

LUBRICATION OF ANTI-FRICTION BEARINGS

(Continued from Page 15)

meet ANG-5A requirements of 300°F. for 300 hours to the textile drying machine builder who must operate 24 hours a day continuously at temperatures up to 400°F., if he is to take care of today's needs.

Present day anti-friction bearings made of 52100 steel do not meet the requirements either. However, the bearing engineer can produce a satisfactory bearing as soon as he can find a satisfactory lubricant.

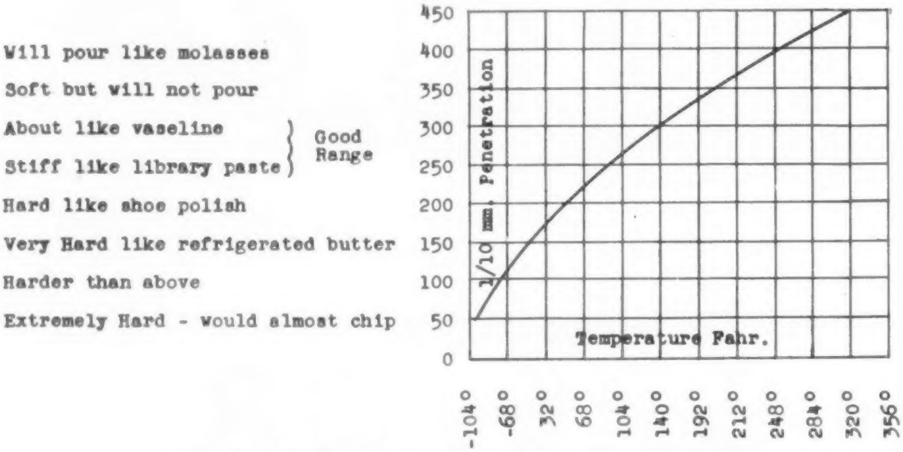


Fig. 19—ASTM Consistency numbers vs. temperature.

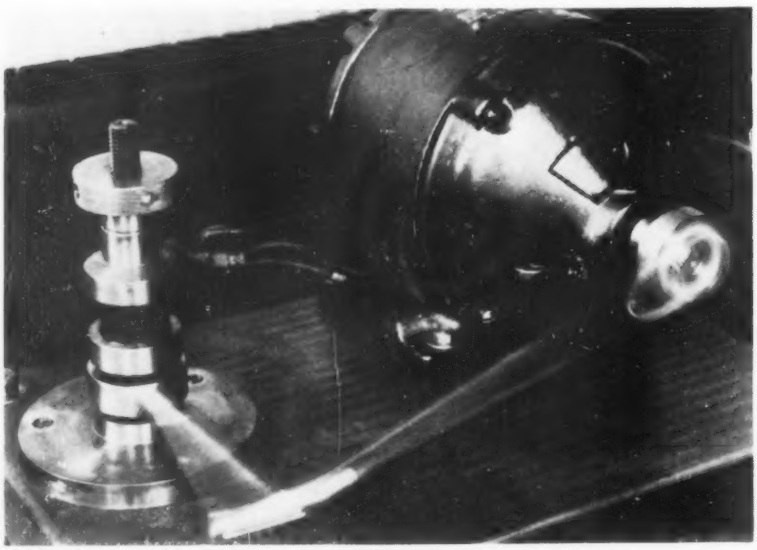
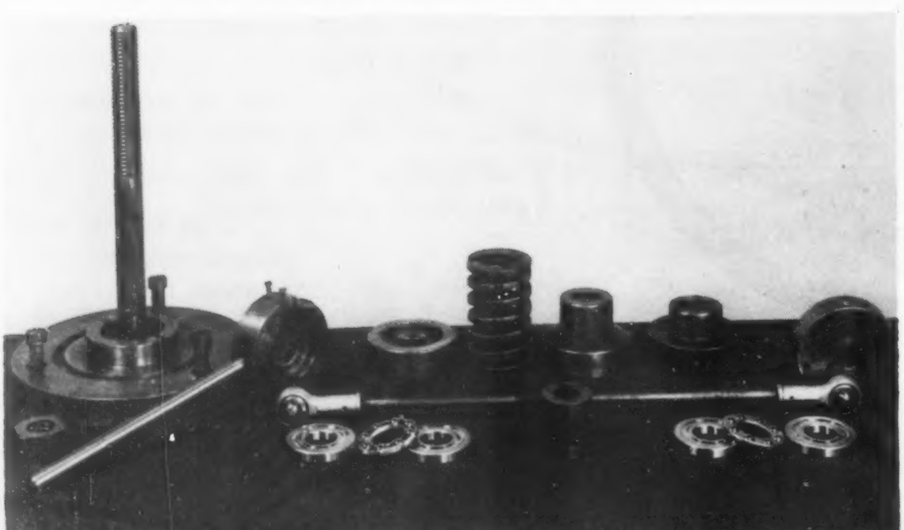


Fig. 20—Fafnir Friction Oxidation Testing Machine.

Fig. 21—Fafnir Friction Oxidation Testing Machine Disassembled.



In cooperation with producers of lubricants the anti-friction bearing companies are continuously testing lubricants. We do not do this for fun, neither are we immediately paid. Our purpose is entirely selfish. The satisfactory performance of our product is, in the final analysis, also the satisfactory performance of the material selected to lubricate it. Consequently, we especially appreciate the cooperation of the producer of lubricating materials who is aware of our needs for an adhesive, mechanically stable, chemically inert, wide temperature range lubricant, of low shear, low noise level, and superior lubricating qualities one which has already hit yesterday's bulls eye.

The trouble seems to be with our mutual customers who continually present new needs for our consideration. This in turn calls for new lubricating materials and new devices for testing them, because in the final analysis we not only make anti-friction bearings but in most cases also lubricate them. This is a dual responsibility which we would gladly share with the first lubricant manufacturer who will guarantee his product to successfully take care of any unknown condition of service our prelubricated product might meet. But he will have to prove it first.

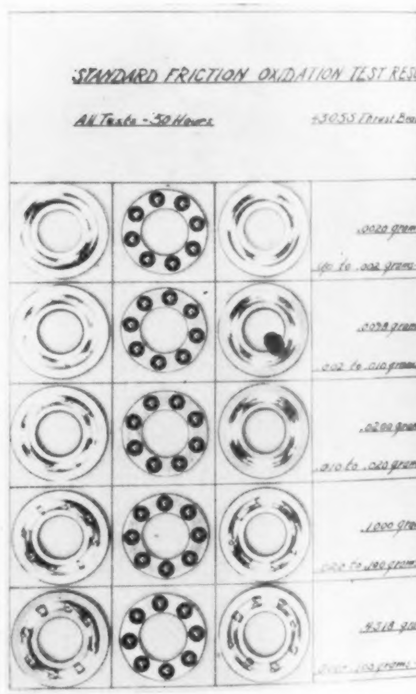


Fig. 22—Group of Test Washers from Fafnir Friction Oxidation Testing Machine.

CHAIRMAN T. G. ROEHNER, DIRECTOR OF THE TECHNICAL SERVICE DEPARTMENT, SOCONY-VACUUM LABORATORIES.

- ASTM LIME SPECIFICATIONS
- WILL DISCUSS THE PUBLISHING OF GREASE ABSTRACTS
- "DELIVERY CHARACTERISTICS" PANEL COMPLETES FIRST TESTS

Considerable progress has been made in following through on the propositions adopted at the Annual Meeting. Mr. Hugh Hemmingway has accepted the Chairmanship of the Subcommittee on the NLGI Classification of Greases. His group will study proposals to maintain the classification in step with requirement of the industry.

Steps have also been taken toward organization of three other Subcommittees, i.e., Editorial, Procurement of Technical Papers, and Planning.

Your Chairman has reported to the Board on the outcome of the survey to obtain NLGI's opinion of ASTM Committee C-7, Subcommittee III's proposed specification for lime for use in the manufacture of lubricating greases. The majority of the ballots returned stated that the subject specification is satisfactory. Opposing votes stated, in effect, that the limits are too broad and that impurities such as magnesium compounds should be further restricted.

A survey of a representative cross-section of the Technical Committee was sufficient to disclose strong support for the suggestion that NLGI contract for a service to supply the Institute Spokesman with material for a new section for abstracts of current published technical information on greases. Therefore, your Chairman has submitted a definite recommendation to that effect to Mr. B. G. Symon for consideration at the January meeting of the Board.

The Panel on "Delivery Characteristics of Dispensing Equipment for Lubricating Greases" has completed the first series of exploratory tests and is studying the data to determine what steps should follow.

The data emphasized the critical part which "slumpability" has in this problem and the next series of tests will recognize the fact that feeding of the greases to the pumping mechanism must be rated as of equal importance to determination of flow rates at the discharge end of the systems.

4-Point Cooperation for OPTIMUM LUBRICATION RESULTS

by HOWARD COOPER

Sinclair Refining Company

Those of us who are concerned with the selection and recommendation of lubricants too often are confronted with the mis-conception that the quality and character of the lubricant are the only factors that determine the efficacy and efficiency of lubrication. Factually, the lubricant is but one element, which, correlated with others, contributes to final results. It is unfair to hold the lubricant supplier solely responsible for the attainment of optimum lubrication performance. The best lubrication accrues from mutual understanding and co-operative effort on the part of

(a) The designer and builder of the machine

(b) The manufacturer of the lubricating accessories or system

(c) The supplier of the lubricant

(d) The operator of the machine

Failure on the part of any one of these to understand the problem, in the overall and in detail, or to exercise the best effort to meet the requirements impairs the attainment of optimum results.

Good lubrication performance actually begins on the drawing board. The engineer and designer envisions what the projected machine is intended to accomplish, and proceeds to assemble and fit together in his mind and on paper, the parts, which working together will produce the desired results. Extensive consideration is given to stresses, pressures and speed, to ambient and frictional temperatures, and to employable metals, all of which have an influence on design of the frame and other components. The parts of the machine must be connected together in various ways to accomplish their individual functions; and again there must be studied the effects of pressures, rubbing speeds, temperatures and the suitability of different types of bearings and bearing metals. Not infrequently these considerations have a major influence on other aspects of the design, or the design as a whole.

The thread-bare yarn about the builder who constructed a machine and then dared the operator to lubricate it is passe'. Designing engineers are very lubrication conscious. They must be; for lubrication is as essential to the operation of machinery as the power to drive it. If the source of power is likened to the heart which gives life to the human body, then lubrication may be compared to the arterial system of the body, without which the pulsing of the heart is ineffectual in sustaining life.

As refinements have developed in materials and in techniques of machine construction, there have been introduced higher speed factors, reduced clearances, and concentrated pressures, which compel closer attention to means and methods of providing adequate lubrication. Moreover, in this mass production era a single machine may be the key unit in an entire process on which the operation of a whole plant may depend, from receipt of raw material to the loading platform. A lubrication failure on one machine may cause the shut-down of an entire plant, with loss of production and revenue, and loss of wages to workers. Recognizing this essentiality many machines are virtually built around a lubricating system, as contrasted to the adaption of a method for lubrication after the machine has been designed and built. It is apparent that the designer has an important part in the beginning if optimum lubrication performance is to be attained.

No one of us can know all that there is to be known about everything. Each one is a specialist to the degree that his interests center about one subject or activity more than others. So the designer, even though he be a mechanical genius who can visualize forms and combinations of parts to create a mechanical wonder must depend on others for detail developments. He will draw on metallurgical research, and on advancements in construction and applications of bearings; and for lubrication ideas he will need to know what the supplier of lubricants, and the manufacturer of lubricating systems can provide. A consideration of these and many other factors which enter into evolution of a successful machine must go hand in hand with the fundamental study of stresses, pressures, rubbing speeds, etc.

As the machine begins to take shape in the engineer's mind or on paper, decisions are to be made regarding the types and sizes of bearings that may be used. At this early stage lubrication enters the picture; for it is here that thought must be given to how lubrication will be provided—what type of lubricant, and through what means of application.

Established practices, proven through experiences are a guide; but if there is never any departure from the historical past, there is no progress. So especially do ideas in advanced design call for study into all the correlated aspects of construction and operation. There must be envisioned and calculated the forces that will be operative on each part of the machine—the strains, pressures and rubbing speeds, and the effect of such forces at detailed points and with relation to the functioning of

the machine as a whole. Outside influences such as anticipated ambient temperatures, dust and humidity conditions, must not be overlooked; they are important and not infrequently decisive factors.

The designer has many aspects to correlate in the mental and actual development of his brain-child, and he can be greatly aided by specialists in other fields. With respect to lubrication that embraces particularly the manufacturer of lubricating systems, and the supplier of lubricants.

To be recognized first are the lubricant suppliers. The broad picture of all the mechanical and ambient conditions involved should be studied to evolve what types of lubricants will render the best service at each point to be lubricated, and what compromises in the interest of minimum number of lubricants or simplicity of application are permissable. From experience and through knowledge of the capability of lubricants and their performance characteristics, products can be selected for the job to be done under the conditions imposed. Not only should existing lubricants be considered, but also new products that could be provided if regularly available lubricants will not serve adequately.

Greases vs. fluid lubricants come up for selection. Here acceptable methods of application, or ambient conditions may be a determining factor. Where leakage and dripping cannot be tolerated, as on food handling and processing equipment, or on some textile machinery, grease may be the obvious and perhaps the only choice. There are many other circumstances where grease is the preferred lubricant, for numerous reasons. These include their ability to provide a continuous effective lubricating film; sealing to preclude the intrusion of dirt and abrasives to the bearings; protection against removal of lubricant when machines are subjected to hosing down, as is practiced on food machinery; the requirement for an adhering film as demanded on vertical or inclined rubbing surfaces. There are many other situations where a grease may be the only or the best choice. That is why greases are made—because they are needed under certain operating conditions. Engineeringly, greases are not competitive with fluid oils; they have their own particular sphere of usefulness and superior serviceability in the lubrication world.

In applying his knowledge to the projected lubricating problem, the manufacturer of greases and oils constantly must have in mind the means of application, what fittings or devices will or can be used, or what lubricating system. No lubricant is of any value if it cannot be applied practically and effectively.

Thus the manufacturer of lubricating systems and devices must enter the scene. Here is a projected piece of machinery, and here are the lubricants which it is judged will most effectively meet the operating requirements. The next question is, what lubricating equipment will provide the most effective and economical means of application. A study of the problem as developed to this point, and consideration of what can be furnished in fittings or lubricating systems, may result in modifications or compromises either with respect to lubricants or to design, or both. Obviously, the lubricating devices or the system must be able to handle the lubricants under all conditions of operation, and must be adaptable to the machine.

A practical outlook must be maintained. Radical departure from established practice, and into the field of the undeveloped may not be sensible. The potential gain in performance efficiency or convenience may not be worth the cost. Possibility of manufacture is not necessarily synonymous with availability. Tailoring a machine and its lubricating system to a special undeveloped and not readily available lubricant may impose unnecessary hardship on an operator.

Before adopting new metals and alloys, which may offer important advantages in design and in service, investigation should be made into the effects that will occur with these untried combinations of materials and conditions. Temperature and moisture may introduce critical aspects, not previously experienced. Some bearing alloys become sensitive at certain temperatures; some lubricants change in character at high or low temperatures. Where seals of synthetic materials are used, compatability of the lubricant must be studied. Below certain temperatures all may be serene, but at high heat levels lubricants not resistant to oxidation and the formation of acidic compounds incident thereto may be damaging to sensitive bearings. Moisture, too, may introduce problems. Then there are bearing metals that

cannot stand even fine abrasive, whereas others take moderate abrasive conditions in stride. These are but a few of the circumstances, and inter relations that require discernment, and which may call for compromises that can be arrived at most intelligently through collaborated study.

In any desire to branch into new adventures with metals and lubricants, the position of the operator must be recognized. It imposes hardship to place equipment in the field before suppliers are ready to serve it. Admitting that the required products can be made, the operator is still handicapped if they cannot be procured conveniently. A result may be the use of unsuitable lubricants with unsatisfactory and even disastrous results. Often patience must be exercised; it may be unwise to attempt to reach the ultimate objective or to take full advantage of potentialities all in one step. There are many complicating aspects which can make it not feasible to introduce something radically new, despite all the advantages that might eventually accrue to all concerned — builder, supplier and operator. Development of lubricants for a new or specific bearing and operating combination may be possible; perhaps such products may have been produced. However, until a reasonable segment of the potential suppliers are ready to serve operators, the time may be too soon to adopt the revolutionary ideas whole hog. Before supplies can be made readily available many obstacles may have to be overcome, in manufacture and distribution. Limited opportunities for wide usage of a product may make manufacture impractical, and costly, which logically enough, discourages development.

At times units have been incorporated into equipment which required special, and up to that time undeveloped, lubricants which were not usable in the multitude of older equipment to be served. To have withheld such mechanical improvement just because regularly available lubricant was unusable would have impeded progress, and no live American would recommend that. In such instances the burdens that are imposed on suppliers and operators are very real; yet through mutual confidence and co-operation progress toward the ultimate goal may be speeded. It will be observed that when situations of this type occur in connection with automotive equipment, it means that every service station must be prepared to service the equipment when it is presented for attention; this involves a tremendous problem of distribution and inventories, but eventually the requirements are accommodated. An example is the ultimate development of multi-purpose gear lubricants, suitable for trucks as well as passenger cars, for hypoids as well as conventional axles and transmissions.

At times equipment builders have assumed the entire burden. Unwilling to wait for suppliers to prepare to serve, manufacturers have unwillingly put themselves in the grease or oil business, providing a necessary but not generally available product as a parts item; then as wider distribution of suitable materials develop such manufacturers usually happily withdraw from that business. The period of development is always a headache period, but tribulation and distress are part of the price that is paid for progress; historically this has always been a phase, while in the end all have benefited by tolerating it and living through it.

In the field of greases there has recently been active development of

multi-purpose greases—the barium, strontium and lithium greases, suitable for a wide range of applications. They are not to be accepted as all things for all machinery; but in these products a single grease has been proven capable of serving purposes that previously required several products. The availability of lubricants of this character may help the designer, if he knows about them—their capabilities and their limitations. Utilizing this development simplicity in design and convenience to the operator may be possible. Up to now naturally such lubricants have been offered for equipment already built and operating. The construction of machinery to take advantage of this development in greases is a different phase, and collaboration between designer, lubricant supplier and manufacturers of lubricating devices may produce a combination accomplishment that can react to the benefit of all, including the operator who should never be overlooked.

From time to time narrow viewpoint comes to attention. Recently a manufacturer of grease cups requested samples of greases for trial in a new device. It appeared that this manufacturer was thinking only of the lubricants which would be effectively handled by the lubricator. From what could be learned no recognition was being given to what sort of lubricant the machine might require for its satisfactory operation. This is mentioned to bring out that perspective must be broad, and should never ignore the requirements of the machine.

On the other hand a salesman of lubricating fittings was found, whose approach to prospective purchasers that showed interest in his device is to suggest that the lubricant supplier's engineer be called in for consultation. He realizes that under lubricant, a product other than that in use might be more suitable. This different conditions of applying the smart salesman shares responsibility for results with the lubrication engineer; their combined knowledge and understanding is the background of the final recommendation, and the device stands less chance of failing to live up to the salesman's claims of satisfactory performance, and the lubricant stands a better chance for a record of high serviceability.

The importance of the operator's position on the lubrication team should not be underestimated. Just as on any team, the failure of, or inability of any member to carry the ball when it is tossed to him may prevent attainment of the goal. The operator has problems to be recognized and to be considered seriously; he should be given a fair chance to do his part well. In a large plant there are established maintenance and servicing procedures, which can be disrupted by a specialized requirement of one machine. The operator has man-power, man-hour and over-time problems; there are situations where a shut-down for lubrication servicing cannot be permitted. Such circumstances should be foreseen and respected in design, lubricating system and lubricant. Simple things like accessibility of lubrication points are not to be ignored; they are definitely important to an operator. A lubrication point accessible for servicing with the right hand generally stands a better chance for attention, than if a more awkward left hand approach is re-

quired. This may seem an inconsequential detail, yet recognition of it may better assure regular and frequent lubrication, and thus promote greater satisfaction of performance and longer life to the machine.

Sometimes the lubrication problem starts at the operator's end of the chain. There may occur changes in shop practices, speed-up to increase production, or the adaptation of machines to other sizes of work pieces or different materials. These are circumstances which were not contemplated in original design of the machines and which may alter the lubrication requirements.

A pertinent example is to be found in the use of rubber working machinery, originally designed for and successfully operated in handling natural rubber. When it became necessary to substitute synthetic rubber, different conditions were encountered; adjustments of speeds and other operating factors were sometimes necessary. Then came rapid developments in the field of plastics; and certain rubber processing plants or machines were put to work on plastics. Cases are reported of bearing temperatures jumping to as high as 300°, where previously 150° had been normal. Under these newly imposed conditions the lubricant previously used was no longer suitable. Methods of application required study, and sometimes re-vamping; the operator had to revise his practices. Nor was the machine builder out of the picture; he holds an interest because the operator is his customer first, and even though a machine is put to a use not originally contemplated, the builder is anxious that the operator be satisfied. Through cut-and-try procedure a solution eventually may be found, but at the expense of damaged bearings, down-time and other headaches. Collaboration among all of the partners in lubrication may bring the answer more quickly and more cheaply, and avoid many of the headaches.

There is no intent here to propose a mechanism for the co-operation and collaboration of the factors responsible for good lubrication; there can be no set pattern. The purpose is to emphasize the fact that lubrication results are a joint responsibility, just as they are a joint interest. Optimum performance can be attained only through mutual understanding of the job to be done and facilities for accomplishment. How it is to be done most effectively evolves from the cooperative efforts of all elements.

The machine designer and builder needs to have understanding beyond stresses and strains, metallurgy and machinability. He must recognize that after the machine is built, its success and the satisfaction to the operator depends a great deal on adequate lubrication. He would therefore fortify himself with a conception of lubricants and lubrication methods, their capabilities and their weaknesses, their relative values and effectiveness under combinations of service conditions. He needs to know the merits of grease vs. fluid oils, to be able to determine where grease or oil can serve best and why; so that design can be created accordingly. He is interested not only in what is available on the market, but what can be made available; although in considering the latter it must be realized that capability of being produced is not necessarily, synonymous with practical manufacture, or availability for purchase.

The machine builder must go still further in his thinking, beyond lubricants per se, and consider how they can be applied. He would seek to ascertain what means and methods have been proven, and what variations thereof or what new methods can be devised if required. A study of application features may indicate that a preferred type of lubricant will have to be rejected from consid-

eration, because adequate means of application cannot be provided.

He must also take into account the problems that face the operator—servicing, maintenance and the touchy labor aspect. The operator is important, for his is the responsibility for keeping the machine running.

The supplier of lubricating appliances, in his position on the quartet, requires some knowledge in the field of lubricants which his devices are built to handle. He should study susceptibility of different types of lubricants to various methods of application. Conscientious recognition must be given to the lubricants selected to serve the machine best; and to the extent possible the lubricating means and devices should be adapted to those lubricants, with due regard to quantity requirements and rates of feed needed for greatest efficiency and economy. Not many machines can be most effectively lubricated with a single product, desirable as that simplicity may be; and the appliance manufacturer must be broad and flexible enough in his thinking to accept that fact, and adapt his proposals to the good of the machine.

The manufacturer of the lubricating system must also have a conception of the designer's problems. Lubrication equipment virtually becomes a part of the machine, and must be designed into it. The lubricating system cannot be worked out independently from the machine. Only through collaborative thinking can the best arrangement be developed.

Correspondingly, the understanding of the grease and oil supplier must extend beyond his specialized and primary interest in lubricants. From the builder and designer he must get facts to enable him to analyze and evaluate the forces and effects that will be imposed by the operating conditions, such as ambient and frictional temperatures, pressure concentrations, clearances and other related mechanical and operational aspects. He must foresee the effects of these conditions on the lubricant, to be able to provide products of necessary properties in consistency or viscosity, resistance to oxidation, rusting, leakage, etc. Collaterally, he must also perceive what the obtainable means of application may be, and in that connection be as ready to adjust himself and his recommendations to the potentialities in lubrication methods, as the supplier of appliances must be willing to recognize the types of lubricants required.

The operator of the machine is on the team also. In the part he plays he must realize and be sympathetic to the problems of the other members of the lubrication quartet. In fairness to them he should not demand the impossible for his convenience. With appropriate conception of lubricants and lubrication methods and design features, and the forces and effects involved, an operator can contribute much to successful lubrication performance. Intelligent attention to the needs of the machine, regular servicing, care and cleanliness, are as necessary as design, lubricants or application methods.

Particularly where the project presents revolutionary ideas, for which there may be no specific previous experience for guidance is collaboration necessary; for perfection in mechanical design has little value, if the machine will fail in service due to inadequate lubrication. Likewise the best of lubricants may be worth little if effective means for application are not provided; and the whole may be upset if the machine does not receive proper attention.

Confidential aspects of designing need be no deterrent to collaboration and co-operative effort. It is seldom necessary to disclose secret details in seeking advice or information from the other partners in lubrication, nor is there necessity for formal consultation. The fundamental thought offered here is that lubrication is a partnership enterprise, that will fall short of optimum attainment unless the knowledge and experience of all the participants is drawn in, dove-tailed and fitted together. It is repeated that all the contributions to good lubrication have an interest in and a responsibility for the operational performance of a machine, and that maximum attainment is accomplished through exchange of knowledge and experience.

The N.L.G.I. and technical societies that attract lubrication engineers and associated technologists offer a common meeting ground for the development of understandings important to all factors in the accomplishment of the best lubrication results.

ABOUT THE COVER PICTURE

"Precision" Front View Distillation Unit

For greater ease and laboratory efficiency in making A. S. T. M. petroleum distillation tests, Precision Scientific Co. has developed the Front-View Distillation Unit. The apparatus on the cover is a 4-unit assembly.

In designing the unit, emphasis was placed on easy operation and the conservation of laboratory space. Two Front-View Distillation Units occupy the same space as one conventional set-up, and consequently make it possible to run two tests simultaneously for check results. The compact arrangement of shield, condenser, and graduate save 50 per cent of linear space. This is accomplished by a "U"-shape condenser tube which also allows all readings and controls to be in front of the cabinet.

The heat source can be either gas or a built-in "Precision" Ful-Kontrol heater. This heater has an auto-transformer that allows practically stepless control up to the maximum wattage, and has a much longer life than a rheostat-control heater. The condenser cooling system employs an ice bath, or a bath containing a copper cooling coil which is connected to a refrigerating unit. A sensitive thermostat and a motor-driven stirrer maintain a uniform temperature of 32 to 40° F., as specified in the A. S. T. M. specifications.

The condenser is equipped with a drain and an overflow outlet. The shield and exterior of the condenser are made of polished stainless steel; the interior is of heavy insulated copper.

The INSTITUTE SPOKESMAN

Published monthly by

THE NATIONAL LUBRICATING GREASE INSTITUTE

HARRY F. BENNETTS .... *Editor*

4638 Millcreek Parkway

Kansas City 2, Mo.

Operations Underway In New Swift Plant

Operations have begun in the new Industrial Oil processing unit of Swift & Company's Technical Products Plant at Hammond, Indiana. First delivery of product was made to Lever Brothers Company, also in Hammond.

The new plant is located on part of a 70-acre tract which is being set aside by the company for further development of technical products facilities. It includes units to carry out three processes, namely, solvent crystallization, solvent fractionation, and fat splitting. These processes are integrally operated for the first time.

Products from the plant will provide raw materials to industries that manufacture such items as cosmetics and toilet creams, soaps, floor waxes and polish, linoleum, phonograph records, candles, shoe polish, rubber products, paint, textiles, wallpaper, printing inks, cleaning and waterproofing agents, leather dressing, buffing and lubricating compounds, insecticides and cutting oil.

Research into new and improved products is to be carried on in an experimental pilot plant as well as in Swift & Company's central research laboratories.

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of the
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REFINERS

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